

1

AIR-CONDITIONING UNIT AND AIR-CONDITIONING APPARATUS

INCORPORATING SAME

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an air-conditioning unit and an air-conditioning apparatus, and in particular relates to technology suitable for use in the deactivation of allergens, which are causative agents for allergic symptoms.

Description of the Related Art

Recently the existence of causative agents causing abnormal reactions (allergies) in the human body has become known. These causative agents are generally referred to as allergens.

When an allergen somehow enters the human body, the immune system of the human body aggressively reacts with the allergens and causes allergic symptoms such as asthma, atopic dermatitis,

2

rhinitis and conjunctivitis. As such allergens, there are known various pollens, mites and fungi.

The majority of the above allergens are drifting in the air. Therefore, most of the known allergic symptoms are believed to be due to inhalation of this air. In an indoor environment prone to cause such allergic symptoms, it is speculated that the allergic symptoms can be alleviated by removing or reducing such allergens from the air.

Therefore, in conventional air-conditioning apparatus used for indoor air-conditioning (cooler, heater and dehumidification), to deal with allergens, it has been proposed to provide an allergen deactivation device such as a ventilation device for actively ventilating the interior, a filter, and a catalyst, and to continuously monitor the amount of allergen by an allergen sensor. Guidelines have been established to realize an operation for actively passing an allergen atmosphere through the allergen deactivation device to deactivate the allergen (refer to Japanese Unexamined Patent Application, First Publication No. 2002-181371).

3

As mentioned above, air-conditioning is often performed in an indoor environment which is prone to cause allergic symptoms due to drifting allergens. Therefore it is desirable to deactivate the allergens by effective utilization of an air-conditioning apparatus. The present inventors have acquired knowledge concerning enzymes which deactivate allergens, that is, related to the presence of atmospheric conditions ideal for activating allergen deactivation enzymes. Activating allergen deactivation enzymes implies stimulating the action of the enzymes to breakdown the protein structure of the allergens. As a result, by breaking down (deactivating) the allergens, the appearance of allergic symptoms can be prevented or inhibited.

From the above background, it is desirable to arrange allergen deactivation enzymes within an air-conditioning unit of the air-conditioning apparatus, and appropriately form a high temperature and humidity atmosphere which activates the allergen deactivation enzymes, so that allergens are effectively deactivated using the air-conditioning apparatus.

4

In this case, it is desirable to minimize the addition of new components to the air-conditioning apparatus, and effectively utilize the essential constituents and functions conventionally provided, to thereby keep down rising costs.

#### BRIEF SUMMARY OF THE INVENTION

The present invention takes into consideration the above situation, with an object of providing an air-conditioning unit and an air conditioning apparatus which can effectively deactivate allergens.

To achieve the above objectives, the present invention employs the following means.

An air-conditioning unit of the present invention comprises: an inlet for drawing in air; a heat exchanger for exchanging heat between air drawn in from the inlet and a refrigerant; a diffuser for discharging air which has been heat-exchanged by the heat exchanger; an airflow device for blowing air from the diffuser; an enzyme carrier arranged in an internal space through which the air flows, and which

5

supports an allergen deactivation enzyme; and an enzyme activation device which creates an atmosphere for activating the supported allergen deactivation enzyme.

According to this air-conditioning unit, since it comprises the enzyme carrier arranged in the internal space through which the air flows, and which supports the allergen deactivation enzyme, and the enzyme activation device which creates (produces or forms) an atmosphere for activating the allergen deactivation enzyme in the internal space, then in the enzyme carrier supporting the allergen deactivation enzyme, when the atmosphere for activating the allergen deactivation enzyme is created by the enzyme activation device, allergens collected in the enzyme carrier can be deactivated by the activated enzyme.

Moreover, the air-conditioning unit of the present invention has an internal air retaining device which retains air flow within the internal space.

By retaining air flow within the internal space by the internal air retaining device, creation of the atmosphere for

6

activating the allergen activation enzyme by means of the enzyme activation device is promoted.

In particular, as the internal air retaining device there is preferably provided an open/close device which closes a part or all of openings communicating with the internal space, to keep the internal space in a semi-enclosed or fully enclosed condition. As a result, creation of the atmosphere for activating the allergen deactivation enzyme by means of the enzyme activation device is facilitated.

As the internal air retaining device, instead of the open/close device, there may be provided an airflow device stop device which stops the airflow device. Moreover, when considering an application to a vehicle air conditioner, there may be provided an airflow path switching damper which can partition a space by switching thereof.

Furthermore, preferably the internal space is kept in the enclosed condition, and the airflow device is operated to agitate the air which constitutes an atmosphere for activating the allergen deactivation enzyme in the enclosed internal space.

7

As a result, the atmosphere of the internal space can be made uniform.

Moreover, in the air-conditioning unit of the present invention, preferably the enzyme activation device heats and evaporates condensed water generated by the cooling operation of the heat exchanger by means of a heating operation of the heat exchanger, which is performed after the cooling operation. As a result, the enzyme activation device can be constructed by the components of a normal air-conditioning apparatus, and a warm humid atmosphere for activating the allergen deactivation enzyme can be formed.

Furthermore, in the air-conditioning unit of the present invention, preferably the enzyme activation device heats and evaporates the condensed water generated by the cooling operation of the heat exchanger, and stored on a drain pan, by means of a heating device. As a result, the enzyme activation device can be constructed by adding the heating device to the components of a normal air-conditioning apparatus, and a warm humid atmosphere for activating the allergen deactivation

enzyme can be formed.

Moreover in the air-conditioning unit of the present invention, preferably after the internal space has been maintained at a high temperature and high humidity by the enzyme activation device, a degradation-prevention operation is performed to remove moisture from the enzyme carrier. As a result, by creating an atmosphere which does not activate the allergen deactivation enzyme, degradation can be suppressed, and the life of the enzyme can be extended.

Furthermore in the air-conditioning unit of the present invention, preferably prior to performing allergen deactivation by means of the enzyme carrier, an allergen collection operation is performed which draws in air to the internal space and passes this through the enzyme carrier. As a result, the allergens can be collected on the enzyme carrier and effectively deactivated. As the allergen collection operation, a normal cooler, heater, or dehumidifying operation may be performed, or simply the airflow device alone may be operated, to perform an airflow operation which circulates the



air.

Moreover the air-conditioning apparatus of the present invention comprises the aforementioned air-conditioning unit, a compressor for compressing a refrigerant, an external heat exchanger for performing heat exchange between the refrigerant compressed by the compressor and air, and refrigerant piping for connecting between the air-conditioning unit, the compressor, and the external heat exchanger, and circulating refrigerant between the air-conditioning unit, the compressor, and the external heat exchanger.

According to this air-conditioning apparatus, since the air-conditioning unit is provided with the enzyme carrier arranged in the internal space through which the air flows, and which supports the allergen deactivation enzyme, and the enzyme activation device which creates in the internal space an atmosphere for activating the allergen deactivation enzyme, then in the enzyme carrier supporting the allergen deactivation enzyme, when the atmosphere for activating the allergen deactivation enzyme is created by the enzyme activation device,

10

allergens collected in the enzyme carrier can be deactivated by the activated enzyme.

According to the air-conditioning unit of the present invention, and the air-conditioning apparatus incorporating this, the following effects are demonstrated.

According to the air-conditioning unit of the present invention, since it comprises the enzyme carrier arranged in the internal space through which the air flows, and which supports the allergen deactivation enzyme, and the enzyme activation device which creates in the internal space an atmosphere for activating the allergen deactivation enzyme, then in the enzyme carrier supporting the allergen deactivation enzyme, when the atmosphere for activating the allergen deactivation enzyme is created by the enzyme activation device, the allergens collected in the enzyme carrier can be efficiently broken down and deactivated by the activated enzyme. Therefore, the allergen concentration in the air can be reduced, and a favorable environment in which allergen symptoms are unlikely to occur can be readily provided.

11

Furthermore in the abovementioned air-conditioning unit, by providing an open/close device which closes a part or all of the openings communicating with the internal space, to keep the internal space in a semi-enclosed or fully enclosed condition, it is difficult for the high temperature and humidity atmosphere of the internal space to leak out to the outside. Hence maintaining the atmosphere for activating the allergen deactivation enzyme by means of the enzyme activation device is facilitated, so that efficient allergen inactivation becomes possible. In particular, if the internal space is in a fully enclosed condition, maintaining the atmosphere is further facilitated.

Moreover, in the abovementioned air-conditioning unit, since the internal space is kept in the fully enclosed condition, and the airflow device is operated to agitate the air which constitutes an atmosphere for activating the allergen deactivation enzyme in the enclosed internal space, the atmosphere of the internal space can be made uniform, and the entire area of the enzyme support bodies can be effectively used

12

so that the allergens can be efficiently deactivated.

Furthermore, in the abovementioned air-conditioning unit, since the enzyme activation device is one which heats and evaporates the condensed water generated by the cooling operation of the heat exchanger, by means of a heating operation of the heat exchanger which is performed after the cooling operation, the function of the enzyme activation device can be obtained by the components of a normal air-conditioning apparatus, and a warm humid atmosphere for activating the allergen deactivation enzyme can be formed at low cost.

Moreover, in the abovementioned air-conditioning unit, since the enzyme activation device is one which heats and evaporates the condensed water generated by the cooling operation of the heat exchanger, and stored on a drain pan, by means of a heating device, the enzyme activation device can be constructed by adding the heating device to the components of a normal air-conditioning apparatus, and a warm humid atmosphere for activating the allergen deactivation enzyme can be formed at relatively low cost.

13

Then after the internal space has been maintained at a high temperature and high humidity by the enzyme activation device, by performing a degradation-prevention operation to remove moisture from the enzyme carrier, degradation can be suppressed by creating an atmosphere which does not activate the allergen

PAGE 15/15 \* RCVD AT 3/15/2006 9:13:24 AM [Eastern Standard Time] \* SVR:USPTO-EFXXRF-5/4 \* DNIS:2738300 \* CSID:USPTO \* DURATION (mm-ss):03-56

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